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"It is a singular fact, that when we can find out how anything is done, our first conclusion seems to be that God did not do it. No matter how wonderful, how beautiful, how intimately complex and delicate has been the machinery which has worked, perhaps for centuries, perhaps for millions of ages, to bring about some beneficent result, if we can but catch a glimpse of the wheels its divine character disappears."

I agree with the writer that this first conclusion is premature and unworthy; I will add deplorable. Through what faults or infirmities of dogmatism on the one hand and skepticism on the other it came to be so thought, we need not here consider. Let us hope, and I confidently expect, that it is not to last;—that the religious faith which survived without a shock the notion of the fixity of the earth itself, may equally outlast the notion of the absolute fixity of the species which inhabit it;—that, in the future even more than in the past, faith in an *order*, which is the basis of science, will not (as it cannot reasonably) be dissevered from faith in an *Ordainer*, which is the basis of religion.

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## THE WHITE COFFEE-LEAF MINER.

[Concluded from June number, p. 341.]

BY B. PICKMAN MANN.

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*Abundance.*—Some idea of the abundance of these insects may be given by stating that, although, as I was frequently told, they were much less destructive than usual during the year in which I observed them, yet from one tree, which I chose for an experiment as not exceptional unless by reason of its size, I picked one hundred and fifty-three leaves in the course of nineteen minutes, endeavoring at the same time to select only those leaves which contained living larvæ, and to leave those from which the larvæ had escaped. Of these leaves forty-four contained recent mines, but the larvæ had escaped; ninety contained one hundred and twenty-two mines still inhabited; the rest contained old mines or blotches made by a fungus which also attacks the leaves.

*Manner of Devastation.*—The injury caused by this insect is due to the destruction of the digestive and respiratory organs of

the plant. The larva "absorbs the sap, obstructs the circulatory channels, and impedes the vegetable respiration" (Madinier, l. c. p. 33), thus depriving the plant of its food, or preventing the food from becoming fit to sustain life, in consequence of which the plant becomes exhausted, and either dies, or bears fewer and smaller fruit.

*Amount of Devastation.* — Guérin says (Mém. etc. p. 12; [Dumeril, Rapp.,] p. 33) that in the Antilles "all the coffee-trees were feeble and languishing: they bore only small and stunted fruits, their leaves were spotted or blackened, in [great] part dried up, and although dead, remaining upon the branches, \* \* which rendered these shrubs languishing, and had even caused the death of many of them." Madinier says (l. c. p. 33) that owing to the attacks of insects, of which this is the most noxious, the culture of the coffee-tree was abandoned in the island of Martinique. This insect is said to lessen the coffee-crop of Brazil by at least one-fifth.

*Enemies: Fungus.* — The leaves of the coffee-tree sometimes turn yellow at the tip or some portion of the edge. The spots thus formed increase in size until they cover the whole leaf, gradually turning to a brown color, by which time the leaf has become dried up. These spots may be easily distinguished from those made by the larva, because the two skins of the leaf which is attacked by this disease cannot be separated, and the color is more uniform, appearing equally on both surfaces of the leaf. I was told that this was the work of a fungus. It attacks leaves which have or have not been injured by the larva, but seems to find more ready lodgment on such part of the leaf as has been injured previously. It appears in these cases to kill the larva within the mine, as many mines recently begun are found to contain the flat and empty skin of the larva, with no indication of another destroyer, but I may have been misled in my judgment by seeing the interrupted labor of the *Eulophus* of which I will speak next.

*Enemies: Parasites.* — I have found two ichneumons parasitic upon the insect: one upon the larva, the other upon the pupa. I have also found great numbers of mites (*Acarina*) living in the mines. The first of these ichneumons, which feeds upon the larva of *Cemiostoma coffeellum*, was found several times under a small roundish blotch of a grayish-brown color (about the same in color as the fungus-spot), which was dotted with black dots, as

if a lichen had grown upon it. These black dots may have been the frass of the larva, which showed through the epidermis.

Where the ichneumon had escaped from these dotted blotches, it had cut out an oval or rounded hole in the upper surface of the blotch. Once, before I broke open one of these mines from which the ichneumon had escaped, I found the pupa-skin *in situ*, with its broken end just touching the hole, through which it could be seen. The hole was about 0.2 millimeter in diameter.

I found several of these blotches which had no hole in them, and yet I found no ichneumon within, but the larva-skin flat and empty. This led me to think that the fungus which I have mentioned may kill and exhaust some larvæ.

According to Ratzeburg (*Ichneumonien der Forstinsecten*, i, (1844), p. 158), this ichneumon belongs to the genus *Eulophus*, in the family of *Chalcididæ*. I have not been able to make a satisfactory figure of it, owing to the injured condition of the only three examples which I succeeded in preserving. It may be called *Eulophus cemiostomatis*, if it has not been previously described.

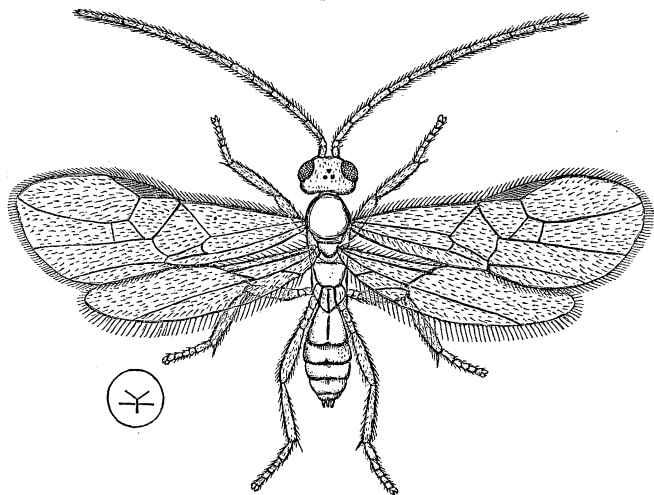
The imago is metallic green or coppery; the wings are transparent, somewhat iridescent; the fore wings crossed by a brownish cloud beyond the middle. The fore wings have no other vein than a double one near the front margin, which is bent at about one-quarter, and ends in a fork at about three-quarters of the distance between the base and the tip, sending one prong of the fork in line with the vein, and the other towards the inner angle of the wing. The inner margin of the fore wing is also thickened for a short distance near the middle; and the front margin of the hind wing is thickened along more than half its length from the base. All the wings are fringed around their margins, and the wings as well as the different parts of the body and legs are pubescent. The antennæ are eight-jointed, thinly haired; the first joint long, enlarged at the apex; the last three joints forming an ovate-conical club; the intermediate four joints ovate-cylindrical. The abdomen is elongate-oval, attached to the thorax by a broad neck, and is turned up at the sides. The tarsi are four-jointed. The length of the head and body is about 0.8 millimeter, the expanse of wings about 1.5 millimeters.

The pupa when seen through the pupa-skin seems to be longer than the imagos.—The pupa-skins look large; all are alike; one or two were sufficiently transparent to allow the occu-

pant to be seen, which was much narrower than the pupa-skin. From one pupa-skin I hatched one of these ichneumons. I found them during all the time (April to June) in which I studied the *Cemiostoma*. In the one hundred and fifty-three leaves mentioned I found eight mines containing these insects. Afterwards I obtained two from a box containing leaves.

The second ichneumon parasitic on the *Cemiostoma coffeellum*, inhabits the larva while it is still in the mine, as I learned by finding an immature example dead within the thin and dried skin of a nearly full-grown larva, but I believe that it usually does

Fig. 130.



Bracon Parasite of the Coffee Moth.

not kill its victim until after the Leaf-miner has become a pupa. It then completes its work of destruction and cuts a hole in the upper side of the cocoon, through which it escapes.

It belongs to that subfamily of the ichneumons called *Braconidæ*; consequently I will call it *Bracon letifer*; but as far as I have examined its characters, it corresponds more nearly to the genus *Rogas* than to any other genus described in Curtis' "British Entomology," and seems to be congeneric with, and judging by the venation of the wings, nearly related to *Exothecus exsertor*, as given in Wesmael's "Monographie des Braconides de Belgique" in the *Nouvelles Mémoires de l'Académie de Bruxelles*, xi (1838), p. 73, and accompanying plate, fig. 10.

The perfect insect (Fig. 130) is honey yellow, except the eyes, ocelli, and sometimes the ocellar space, which are black. The antennæ are also black, and consist of twelve slender, sub-equal, uniformly cylindrical joints beyond the scape, which seems to consist of two short, stout joints, making fourteen in all. The head is transverse; the front projects slightly beyond the eyes; the hind margin of the vertex is emarginate, the emargination filled with the upper edge of the occiput. The three ocelli are arranged triangularly; in some examples they are approximate, in others distant, which may be a sexual difference. The neck is distinct; the back of the mesothorax sub-hexagonal, rounded, tapering anteriorly. In some of my examples the abdomen is elongate, subclavate; in others it is rotundate. I think the shape given in the figure is the most lifelike. In some examples the veins near the extremity of the wings are very feebly developed. The wings are fringed. The legs, abdomen, thorax, head, antennæ and wings are pubescent. Length 1·9 millimeters; expanse 4·7 millimeters. The immature example, or pupa of the *Bracon*, which I found as stated above, had wing pads instead of wings. These were dark, smoky black, 0·5 millimeter long. The antennæ are honey yellow, instead of black, as in the developed specimens. They lie along the breast, and reach to the end of the posterior femora, which is about the length of the whole body. The first two joints are retracted within a cavity in the front of the head, which seems to be the result of a doubling in of the front. Only the two posterior ocelli are visible, distant, and though enough of the front remains to contain the anterior ocellus, it seems as if it must be still farther forward than in the imago. The hind pair of legs is stuck straight out behind. (The abdomen is broken off.) The first and second pair of legs have the femur folded forwards; the tibia and tarsus lie towards the end of the body. This example lay within the skin of the larva, with its head towards the head of the larva.

A possible enemy is a greenish-yellow spider which draws down the edge of a coffee-leaf on the under side, and spins a light web from this edge to the surface of the leaf, leaving each end of the nest open.

*Geographical Distribution.* — As we have stated, M. Perrottet met these insects in the Antillès; M. Madinier found them in the island of Martinique; and I observed them in the Province of

Rio de Janeiro. They are said to extend over the whole coffee-region of Brazil.

*History.* — Dr. Christovão, and his brother Col. Antonio Corrêa e Castro told me that the coffee-trees were first introduced into Brazil by the Brazilian Minister at Paris, who sent two plants to the city of Rio de Janeiro, where they were planted on Mount Tijuca. From these two plants many others were obtained, which were kept in gardens as ornamental shrubs. Some of these were afterwards distributed to the plantations to be cultivated for commercial purposes. From them sprung the coffee-plantations of Brazil. Until about twenty years ago these plantations were free from all noticed pests. About that time, owing to the general exhaustion of the coffee-trees through long bearing, the Government imported quantities of new plants from the Antilles and from the isle of Bourbon, and distributed them all over the country. It was noticed during the very next year that the leaves of the coffee-tree were attacked by the larva of the moth, whose history is given here, which has ravaged the coffee-plantations of Brazil ever since. It cannot be doubted that the insects were brought from the Antilles with the plants, and that a proper examination of the plants at that time, by any person familiar with the appearance and habits of the enemies of the coffee-tree, would have prevented the introduction of so great a pest.\*

*Remedies.* — The entomologist, like the physician, finds it much

\* *Bibliography.* 1. Guérin-Méneville et Perrottet. Mémoire sur un Insecte et un Champignon qui ravagent les Cafés aux Antilles. Paris. Ministère de la Marine. 1842. 8vo. pg. 40. tab. 2. Gives the history of *Elachista coffeella*.

\* 2. Revue Zoologique. 1842. p. 126-127. Contains a notice of No. 1.

\* 3. Annales de la Société Entomologique de France. 1842. T. XI, Bulletin, p. II. Contains a notice of No. 1.

\* 4. Zeller. Linnaea Entomologica. 1848. T. III, p. 250, 272-273; T. II, tab. II, fig. 37-39. Establishes the genus *Cemiosstoma*.

\* 5. Stainton. The Natural History of the Tineina. 1855. Vol. I, p. 284-334, tab. 1. Contains "General Observations on the genus *Cemiosstoma*," and the history of *C. sparti-foliellum*, *laburnellum*, and *scitellum*.

\* 6. Nietner. Observations on the Enemies of the Coffee-tree in Ceylon. Ceylon. Published at the Ceylon Times Office. 1861. 8vo. pg. 31. On p. 24, mentions *Elachista coffeella*.

\* 7. Stainton. The Entomologist's Weekly Intelligencer for 1861. Vol. X, p. 110-111. "A few words respecting *Cemiosstoma coffeella*; an insect injurious to the Coffee plantations of the West Indies."

8. Madinier. Revista Agricola do Imperial Instituto Fluminense de Agricultura. No. 3. p. 29 et seq. Brief notice of the Coffee-tree, containing on p. 33 an account of the habits of an insect called "*noctuella*," which must be the *C. coffeellum*.

(The asterisks before the titles of the above works indicate that I have taken the titles and references directly from the works cited).

more difficult to choose a proper remedy for a disease with which he is familiar, than to trace out the nature and progress of the disease. But at this day the science of entomology, particularly in its practical application, is of such recent origin, that it suffers under a disadvantage from which the practice of medicine is free, namely, it possesses no treasury of results drawn from experience. The practical entomologist can only recommend measures to be put to the trial, and in this way gradually gather a body of experimental facts which may serve as a guide in the future.

The most obvious remedy which suggests itself is the collection and destruction of the leaves which contain the living larvæ. If this was done thoroughly, it would no doubt result in the complete extermination of the pests, a result the value of which would be incredible.

Towards this end Guérin recommends (*Mém.*, etc., pp. 18-20) that "the branches of the coffee-trees which are loaded with [infested] leaves should be cut off in all parts of the country at one time, and burned, while the insect is in the larva state." If this were done, he says, "these coffee-trees should be cut down in such manner that the vegetation could resume its ordinary course shortly after the operation, to the end, if it were possible, of not having to regret but one crop of coffee. \* \* To attain this condition more promptly, the operation in question should be made with a cutting instrument, and at a height which should be determined by the proprietor himself (a metre and a half). Care should be taken to preserve here and there some young and vigorous branches, which would tend to maintain the equilibrium of the sap in all parts of the plant. \* \* Afterwards the development of new leaves ought to be watched with the greatest exactness, and if there should appear from place to place some spotted leaves, they should be destroyed promptly."

It will be seen that Guérin expects to cause the loss of one crop of coffee in his endeavor to exterminate the insect. Certainly the issue of the experiment, if successful, would be well worth the loss of an entire crop, but I think the same result could be obtained in a preferable way: entailing much more labor, but avoiding at the same time the loss. Probably not a single branch would be free from infested leaves, so that it would be necessary to find some other means of killing the larvæ in the leaves of those branches which remained. On the other hand, many healthy



leaves would be lost, if whole branches were cut off. I think it would be better to pick off all the infested leaves, and burn them, leaving the healthy leaves to support the tree. Guérin says [Mém. etc., p. 19] that "the epoch which it would seem ought to be the most favorable for this operation would be that which immediately follows the winter season, or that during which the temperature is the lowest, because the larva finds itself then as it were benumbed, and cannot be transformed into a moth until the return of a softer temperature." The time appointed for picking off the leaves might be, for the obvious purpose of saving labor, that at which the smallest number of old leaves remain upon the trees, if there is any such time. If the leaves were picked at such time as to take the greatest number of larvæ when they were about two weeks old, it would not be difficult to select them, as the size of the blotches would make them very noticeable.

I have made a theoretical estimate of the expense which would be incurred in picking off the leaves as I recommend, and of the relative increased yield of coffee which would result on a plantation of given size. Testing this theory by the numerical data given to me by Dr. Christovão Corrêa e Castro, and making large allowances for unfavorable circumstances, I find that the expense would be more than met by the next year's crop; but even if this should not be the case in the second year, it must be remembered that such a thorough and expensive war upon the insects never need be made more than once, and that with vigilance the trees could be kept in good order and the *increased yield maintained* continually afterwards. But vigilance must be exercised. One picking would not entirely exterminate the insects, however thoroughly it were done. The planters should also make experiments at all times, and seek other means of destroying not only this but all the enemies of their crops. They alone have the facilities for increasing and utilizing all the knowledge which can be gained upon these subjects.

Another remedy which Guérin recommends is "to kindle fires at all points of the coffee-plantations, at the time when the moths begin to issue from their cocoons. It is well known that many insects, and above all the nocturnal Lepidoptera, are attracted by light, and come whirling around a fire until they are burned there. Certainly a great number of individuals would be thus destroyed. At the same time, and to attain this object more promptly, lighted

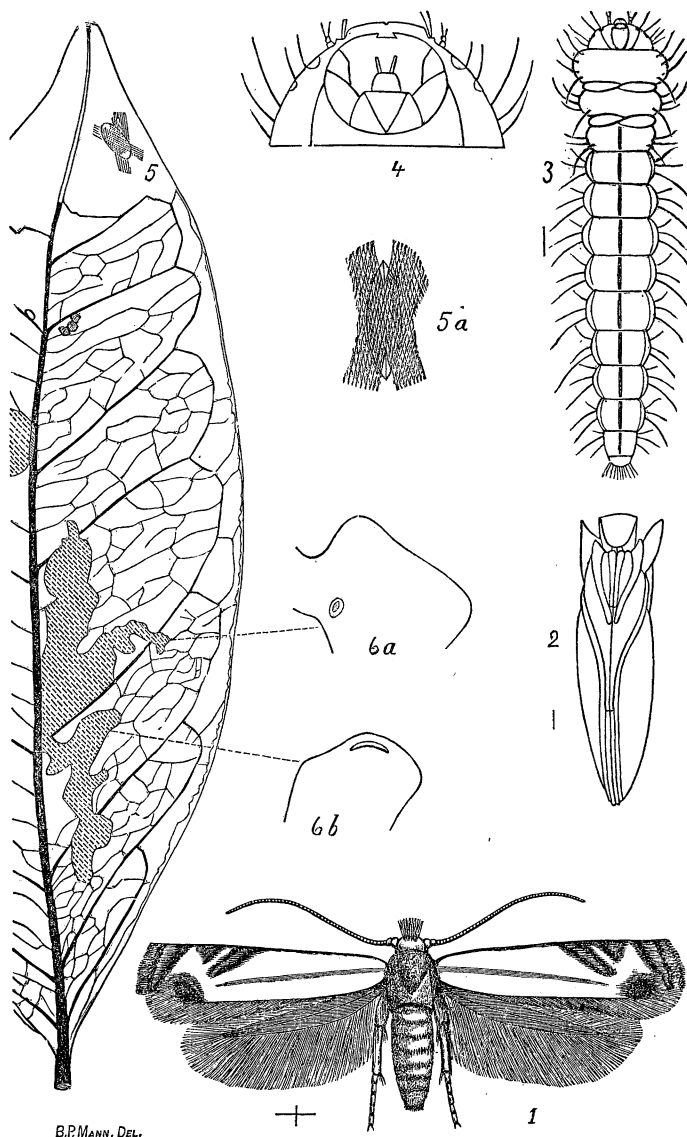
torches might be carried through the plantations in the evening. Thus a crowd of moths, hidden in places to which the light of fixed fires could not penetrate, would be attracted, and killed." Although this measure would not be absolutely efficacious, unless practised for a long time and together over the whole country, which would be difficult to accomplish, yet it would repay all the labor expended upon it, if adopted at the time when the moths were abundant.

I will also recommend again the use of Col. Sorsby's process, which I have described at length in my report upon the enemies of Maize, drawing the description of it from the Report of the United States Commissioner of Patents for the year 1854, Part iii, p. 65.

I have thus stated all the direct means which have been suggested for the suppression of these pests. It is evident that none of them can be adopted without the expenditure of much time and labor. If other measures, less direct, could be employed, which would add to the efficiency, or take the place of those already suggested, the benefit would be great. Whatever measures are employed, however, must be founded upon certain general principles, in order to insure their success. What those principles are must first be learned, and then in what detail they can be applied. It is only in this way that we can determine whether there is any mode of opposing our insect enemies which will not cost more than it is worth.

Men gain time to advance in civilization and prosperity, by mastering the laws of nature, and converting natural forces into tools which do their work automatically as it were. Nature has provided enemies for the moth whose history we have been studying. Let us only learn how to cherish and encourage these natural friends of ours, and they will work for us thoroughly. They were made to work for us whenever we should learn how to command them.

I recommend that before the picked leaves are burned they be placed in an apartment from which the moths cannot escape, and there allowed to lie until the insects have developed. If such an apartment should be made with sides of glass, and a properly guarded entrance, it would be easy to capture the parasites while they rested on the glass, and to liberate them in the plantations, or transport them to other parts of the country where they might be needed more. At the same time the moths could be caught



MANN, ON THE WHITE COFFEE-LEAF MINER.

(Corrected.)

and killed. Or the sides of such an apartment could be made of gauze, fine enough not to allow the passage of the moths, but yet large enough to let the parasites out. Such a building could be placed in the midst of a plantation. I believe that eventually we shall have to rely mainly upon such indirect measures as a protection for our crops. It might even be worth while to undertake a positive cultivation of the parasites, at least at those times when the race has greatly diminished in numbers. It has often been observed, in studying the history of those insects which are subjected to unnatural conditions by man's cultivation of the ground, that there is an alternation of years or of series of years in which the insects are found to be very destructive, or to have almost entirely disappeared. These alternations are partly due to the influence of the seasons, but largely to the attacks of other insects. At first the destructive insects are found to be very numerous, but an examination will show that they have already been attacked by parasites which kill them, while the parasites themselves develop. This process goes on until the parasites have so far outnumbered their prey as nearly to exterminate them, when they will no longer be able to find food, and will themselves perish. Then once more the destructive insects will have an opportunity to multiply, and so the rotation will be continued. Now it is at the time when the destructive insects have been reduced to the smallest numbers that the enlightened agriculturist will find it most practicable to adopt such measures that their numbers may never again increase. Knowing how rapidly these insects increase, when not held in control by the forces of nature, he will feel that every effort of his to stop them at the first step will be an investment of labor at compound interest for a long time to come. Who then would count the trouble? But he must know what to do.

P. S.—I desire to correct an error in the former part of this biography, kindly pointed out to me by Mr. V. T. Chambers, of Covington, Kentucky, in the current volume of the *AMERICAN NATURALIST*, p. 489-490. On p. 338, I said that *C. coffeellum* was the only species of the genus known outside of the limits of Europe. This is a mistake. While I was in Brazil, Mr. Chambers described in the *Canadian Entomologist*, iii (1871), p. 23-25, a species from the United States, called *C. albella*.

As all but one of Mr. Chambers' references, in his note of correction, were wrong, I must, in order to be able to compare his species with the others of the genus, suppose it also due to negligence that he (through Mr. Stainton) describes the silvery gray metallic spot of the fore wings as apical, instead of at the inner angle. If this supposition is correct, *C. albella* seems more nearly related to *C. coffeellum* than any of the other species, but may be known from it by having the spot at the inner angle of the fore wings silvery gray metallic, with very distinct black margins before and

behind, and an indistinct pale golden streak along the base of the fringe from the costa not quite to the inner angle; while it seems not to have the two oblique lines of black scales described in *C. coffeellum*, nor the golden band which partially surrounds the spot in that species.

Mr. Chambers says also, in his note of correction, that "in the Transactions of the London Entomological Society, Ser. 2, Vol. v, pp. 21 and 27, and in Ser. 3, Vol. ii, p. 101, certainly two, and if my [his] memory is not at fault, three species [of *Cemiostoma*], are described from India." I have examined the pages to which he evidently intends to refer, and find that both the species mentioned, *C. waillesellum* and *C. lotellum*, are said to come from England.

I have had a new edition of the accompanying plate struck off, because the former one contained some errors introduced by the artist, who transferred my figures from paper to wood. Some of the figures are incomplete, because I have only drawn what I could see. This is especially the case with the larva.

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## ON THE OCCURRENCE OF FACE URNS IN BRAZIL.

BY PROF. CHARLES FRED. HARTT.

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ON my visit last year to Brazil, my good friend, Senhor Ferreira Penna, showed me in the Museum of Pará a remarkably fine, well-preserved, and curiously-shaped burial vase of the class called by the Germans *gesichtsurnen*, or *face urns*, which had been obtained from a cave on the Rio Maracá, a little river in the Province of Pará, emptying into the Amazonas some fifty miles above Macapá. Of this urn, at his desire, I made the accompanying rough sketch with a few notes for publication in the NATURALIST.

The urn was intended to represent a human figure sitting on a low bench or stool. The body is cylindrical and, including the stool, is just about two feet in height.\* Its diameter is about 9 inches. The legs spring from the body at a distance from its base equal to about one-fifth the height of the body. They are very short, small, cylindrical and hollow. They bend slightly to represent the knee, below which is a broad constriction intended for an ornament. Below this the leg swells to a ball as represented in the engraving. The feet are flat, irregular in shape, cut off squarely in front and furnished with six toes each. They are so constructed as to rest on the ground. The arms have their origin at a distance from the top of the body of the urn less than a

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\*The measurements given in this article are approximate, but were carefully estimated.